ANNIE Update and Status

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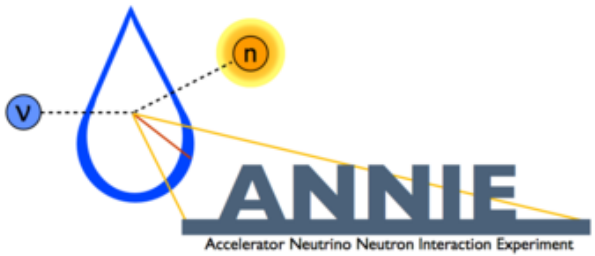
Iowa State University

March 21, 2016



What is ANNIE?

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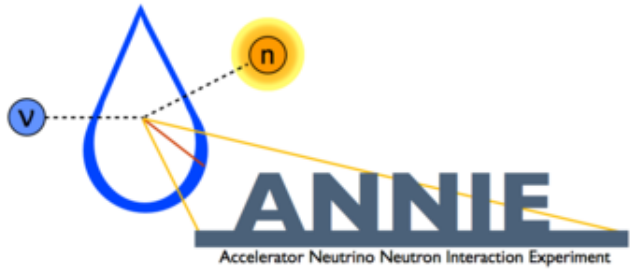
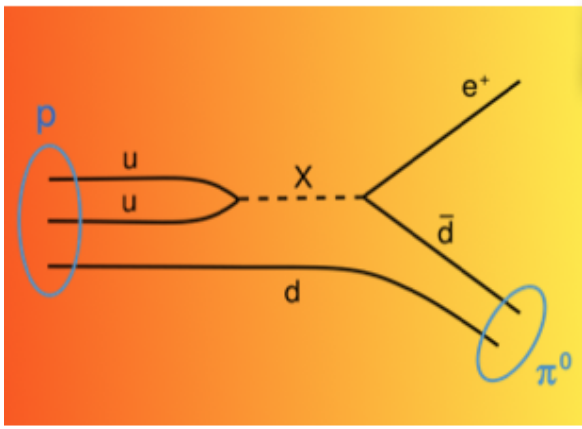
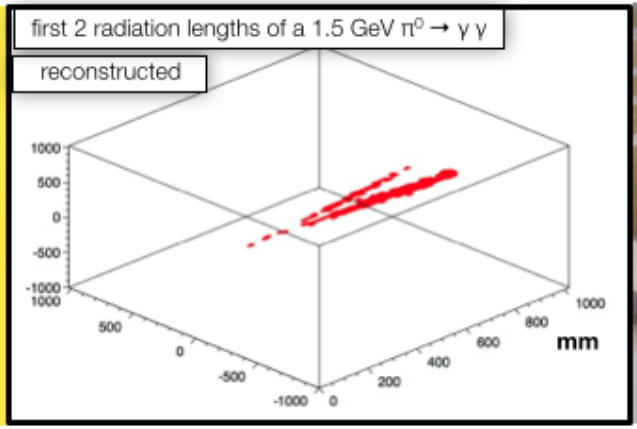
- A measurement of the abundance of final state neutrons from neutrino interactions in water, as a function of energy



for understanding neutrino-nucleus interactions and addressing a limiting factor in proton decay and supernova neutrino physics





- A new technological path for the Fermilab neutrino program

Phased Approach

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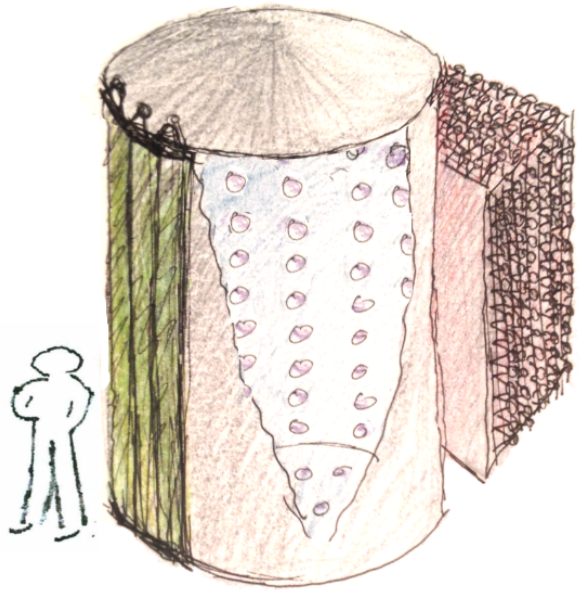
- Phase 1 : "Proof of Concept" run - measure background neutron rates
  - Approved by Fermilab PAC
  - Need to understand neutron backgrounds
    - Skyshine - neutrons from the beam dump that migrate into the Hall from above
    - Dirt neutrons - neutrons produced by neutrino-rock interactions upstream of the Hall
- Phase 2 : Physics run - LAPPD coverage, enhanced PMT coverage
  - Initially focus on CCQE-like events
  - Photodetector R&D
    - Large Area Pico Photo-Detector (LAPPD) - large, flat-panel microchannel plate-based photosensor with 50-100 psec timing resolution and < 1 cm spatial resolution



ANNIE

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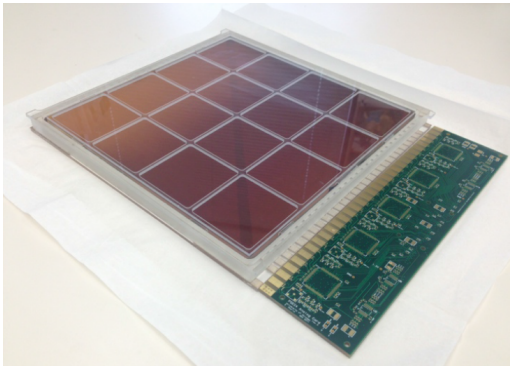
- Taking advantage of the reuseability of Fermilab facilities
  - Repurposing the SciBooNE Hall
- A combination of old and new parts
  - Reusing PMTs from SuperK, NIM/CAMAC/VME electronics
  - Developing LAPPD for commercial use



- Making the SciBooNE Hall ready for future users
  - Added a forward veto wall
  - Refurbishing the Muon Range Detector (MRD)

ANNIE Run I

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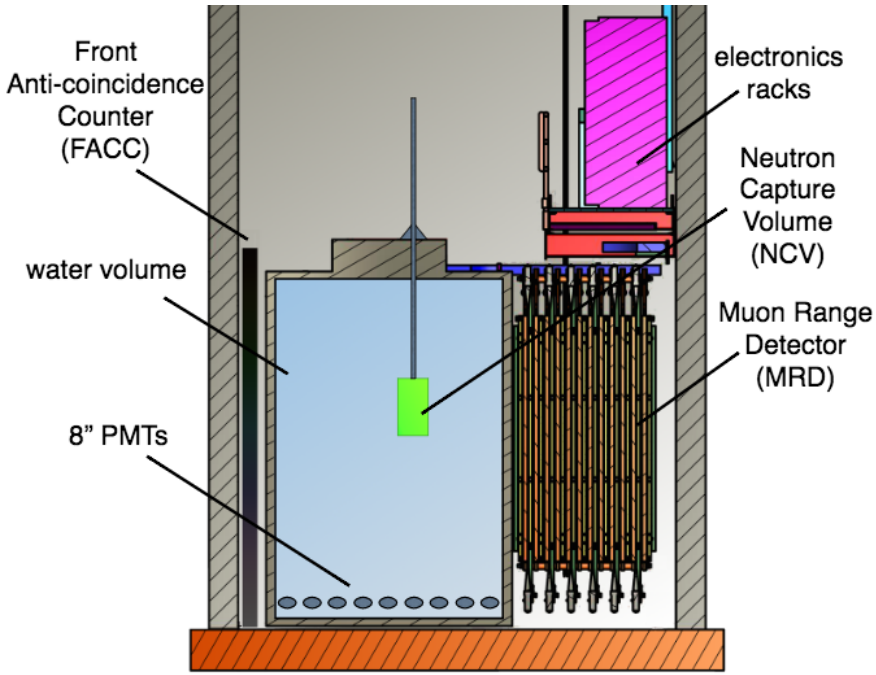
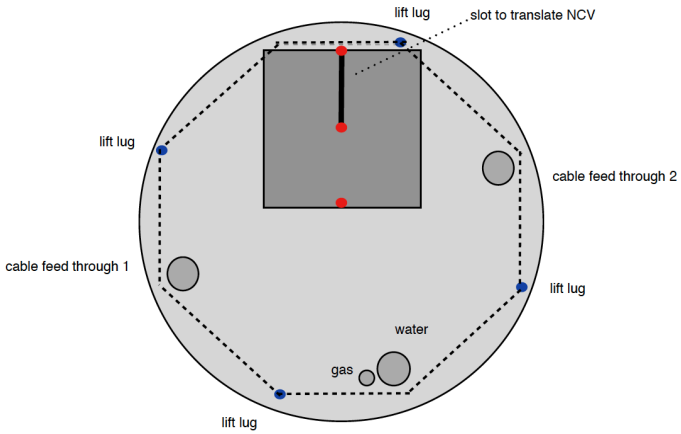
- Sits ∼100 m downstream of the Booster Neutrino Beam target
  - spill 4x10^{12} POT, E_ν peaks at 0.6 GeV
- ∼30 ton water Cherenkov detector
  - Sixty 8" Hamamatsu PMTs (recycled from SuperK)
  - Forward Veto Wall (26 channels)
  - Muon Range Detector (55 channels)
- A small, movable gadolinium (Gd) doped scintillator target



NCV not to scale

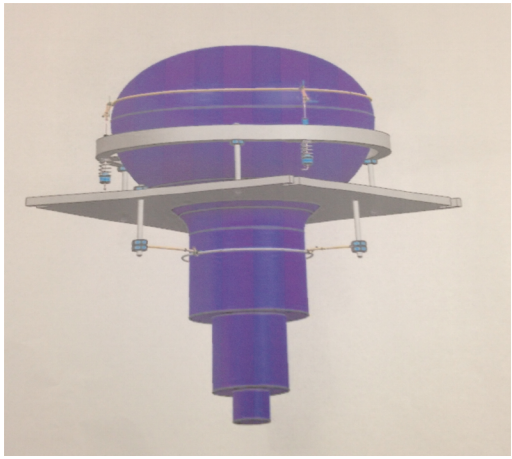
Tank and Inner Structure

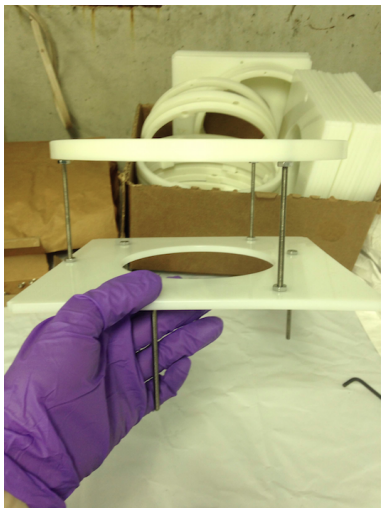
- Worked closely with Fermilab personnel (Jim Kilmer, Kurt Krempetz) to design the tank top and inner structure
- White liner as primary containment and reflective surface

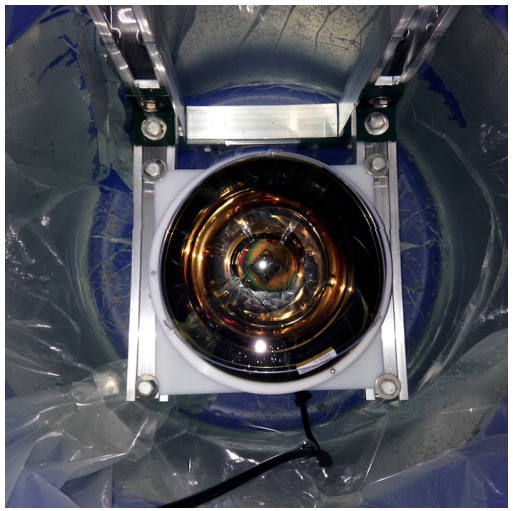


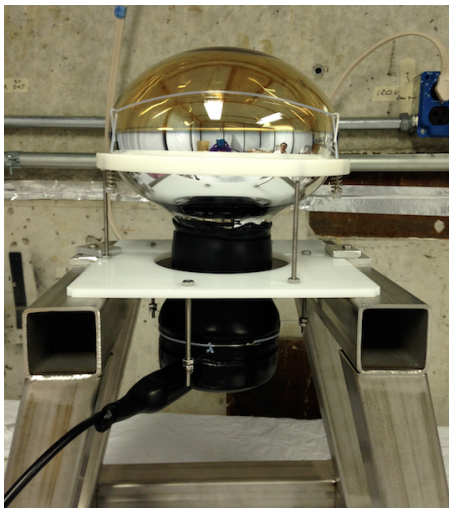
PMT Mounts

- Tested the prototype design as it progressed with Jim Kilmer
- Wrote assembly procedure, with safety considerations, and trained collaborators



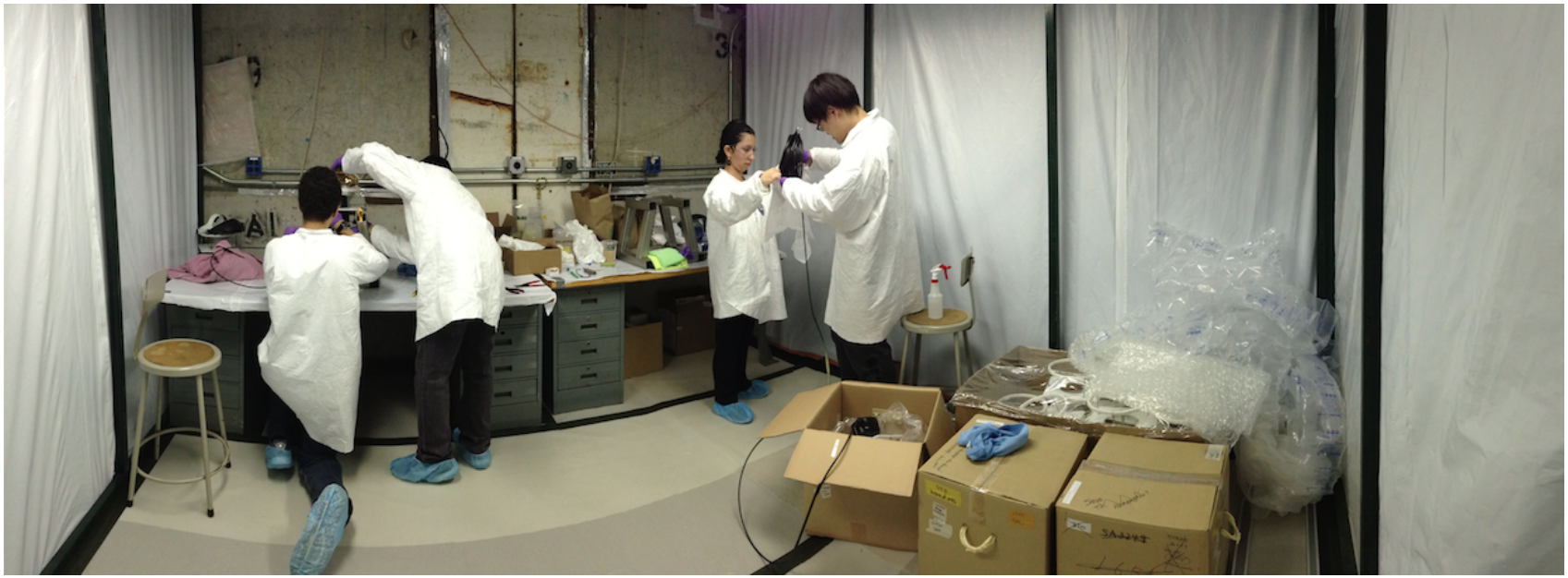






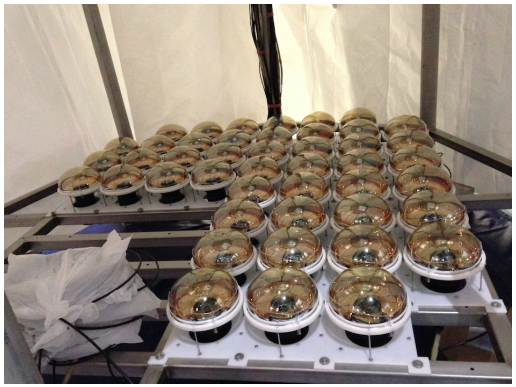
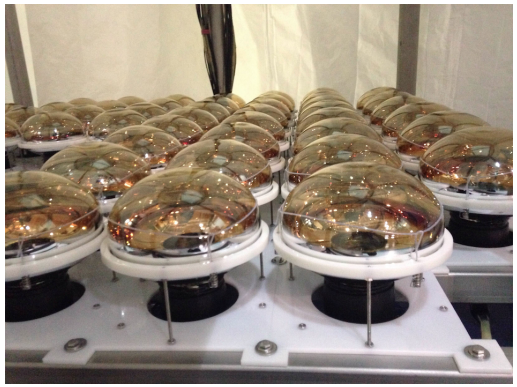
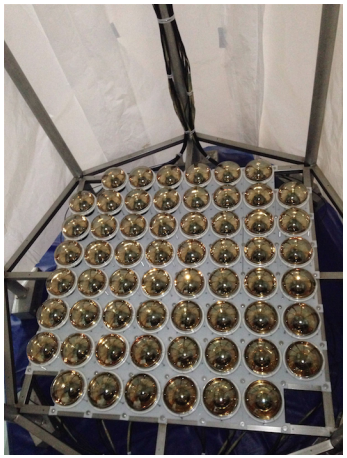
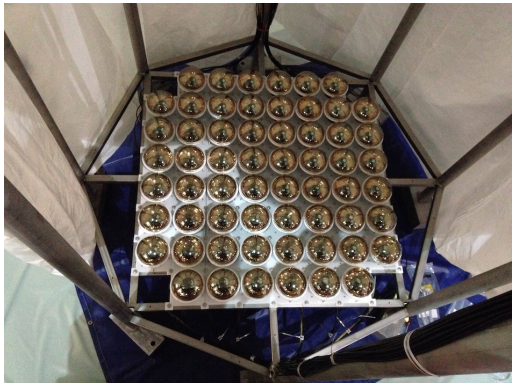
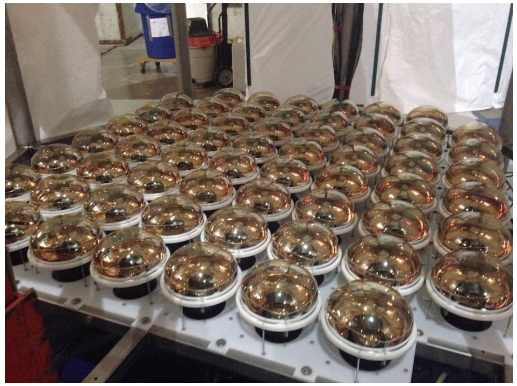
Detector Assembly

- Clean room built in DZero Assembly Building (DAB) low bay
  - Inner structure was wrapped for PMT protection
- Teams of two to clean and mount



Detector Assembly

- Installed a quadrant at a time and then ran cables to the top

Finished Detector!

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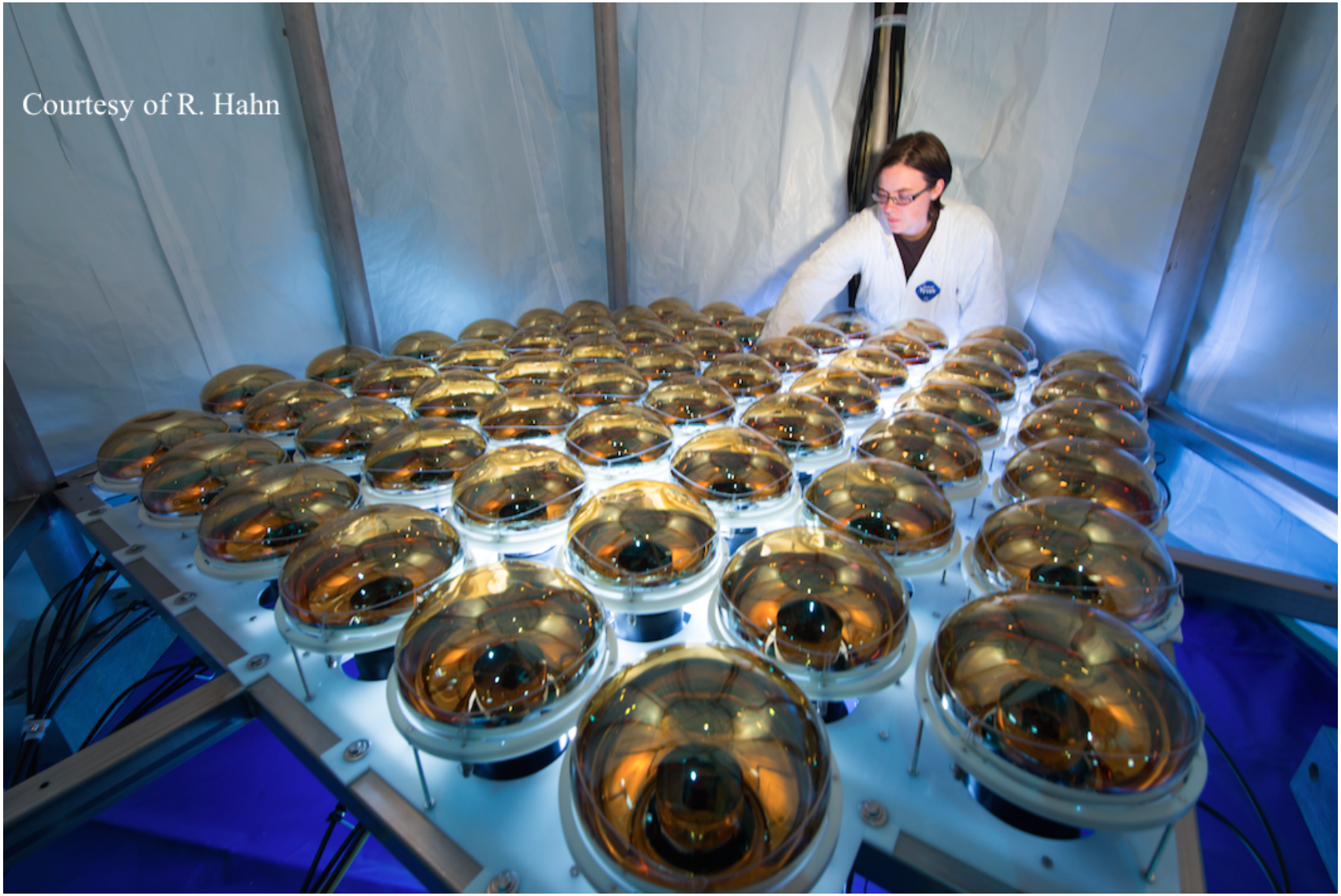
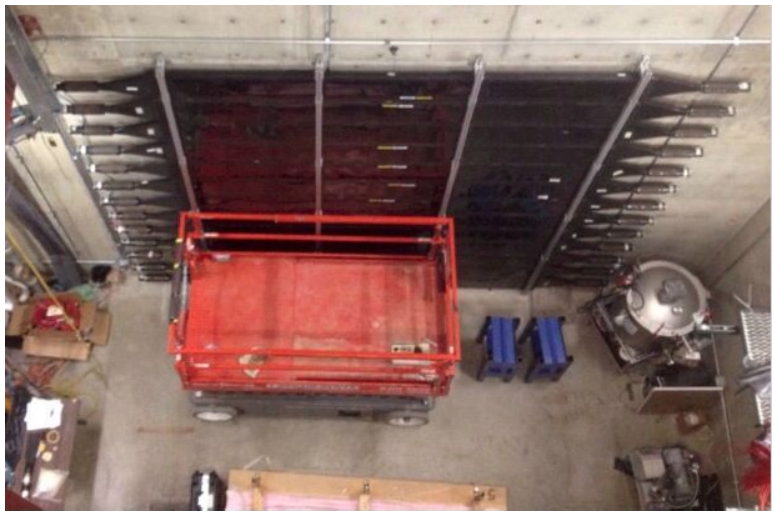
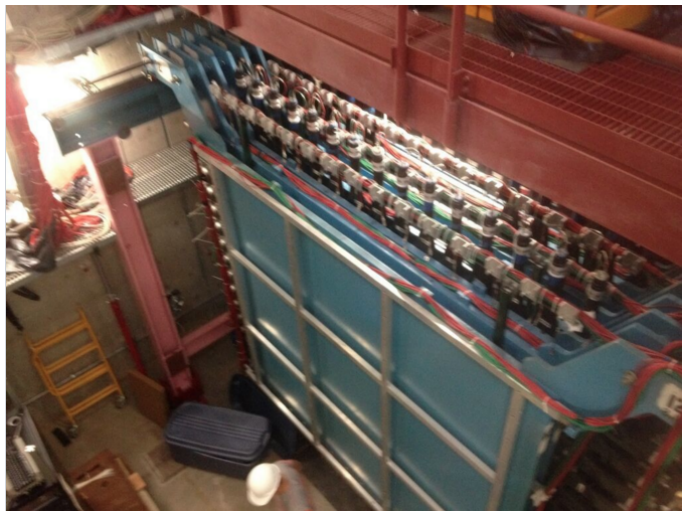


SciBooNE Hall Readiness

- Getting the Hall ready for operations
  - Installed the forward veto wall over the summer
  - Resurrecting the MRD (layers 2 and 3), last used by SciBooNE





Tank Installed Monday Feb. 29th

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Detector Followed on Tuesday Mar. 8th

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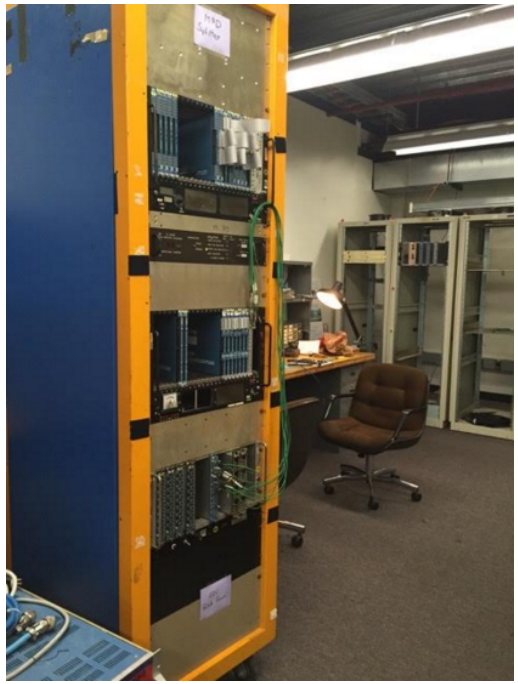
Electronics

- HV system already installed in the Hall
- Crates (VME, CAMAC, NIM) have been moved into the Hall
- DAQ, Gateway computers are configured and running at DAB
- pORC approval of VME electronics rack at DAB



Upcoming Work the Next 1-2 Weeks

- Finish laying HV cables and signal cables
- Get ORC approval for electronic racks at the Hall
- NCV is here on-site, awaiting commissioning and installation
- Commission the detector (sans water) within the next week
- Fill tank within the next two weeks
  - Water skid is here, we have it for a month (until April 7th)
- We have space in ROC-West, need to set up monitoring

Thanks to Fermilab Support!

ISU

- Bill Lee, Geoff Savage
- Kurt Krempetz, Jim Kilmer and his group
- John Voirin and his group
  (John Cornele, Tom Olszanowski, Tim Griffin)
- Mike Matulik, Mike Cherry
- Steve Huey, John Chyllo
- Safety/Rack Protection
  (Steve Chappa, David Mertz, Eric McHugh, Linda Bagby)

ANNIE Collaboration

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The Collaboration

34 collaborators

15 Institutions

- Argonne National Laboratory
- Brookhaven National Laboratory
- Fermi National Accelerator Laboratory
- Imperial College of London
- Iowa State University
- Johns Hopkins University
- MIT
- Ohio State University
- Ultralytics, LLC
- University of California at Davis
- University of California at Irvine
- University of Chicago, Enrico Fermi Institute
- University of Hawaii
- Queen Mary University of London